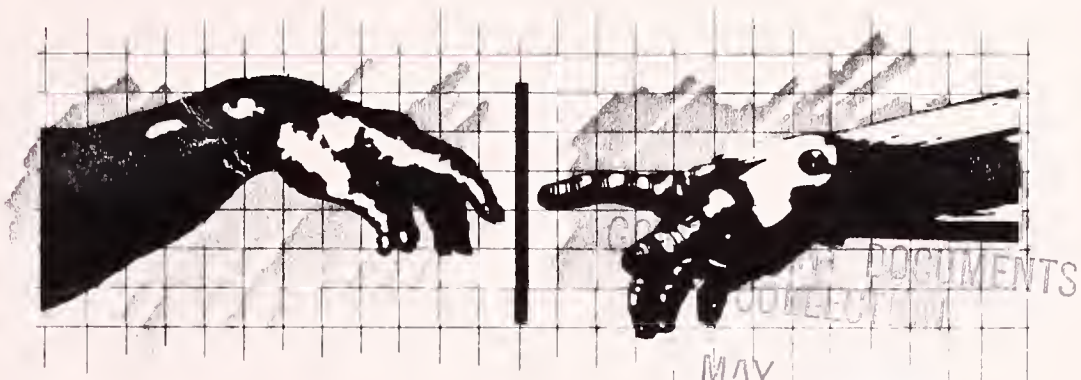
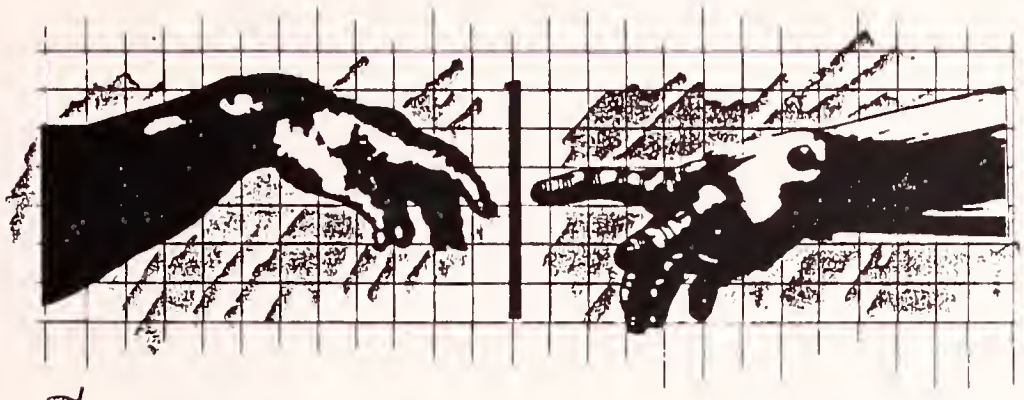


Smart Choices:

Developing Artificial Intelligence for Massachusetts



Smart Choices:

Developing Artificial Intelligence for Massachusetts

BIOGRAPHICAL DATA

A symposium for business people, academicians, state legislators, other government officials and the public.

COMMONWEALTH OF MASSACHUSETTS
SENATE SPECIAL COMMITTEE ON
LONG RANGE POLICY PLANNING
STATE HOUSE, BOSTON 02133

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CHAIRMAN
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TEL. 722-1646

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SEN. MICHAEL J. BARRETT
SEN. JOHN P. BURKE
SEN. A. PAUL CELLUCCI
SEN. PETER C. WEBBER

CYNTHIA M. COSTAS-CENTIVANY
DIRECTOR

ROBERT W. PREER
ASSISTANT DIRECTOR

State Senator William B. Golden (D-Weymouth) was raised in Cohasset, Massachusetts. He graduated from Yale University with a Bachelor of Arts in Political Science and earned a Juris Doctor from Boston University Law School and a Masters in Public Administration from Harvard University.

Senator Golden is the Chairman of the Special Senate Committee on Long Range Policy and Planning, Senate Chairman of the Special Legislative Commission on Liability for the Release of Oil & Hazardous Materials and Senate Chairman of the Joint Committee on Counties. He serves on the Joint Energy Committee, the Joint Public Service Committee and the Joint Committee on Criminal Justice and also has served as a member of the Special Joint Committee on the Investigation and Study of the Pilgrim State Nulcear Generating Facility at Plymouth.

Senator Golden has been active in the South Shore Chamber of Commerce since 1979 and has recently worked with the Chamber in support of such legislative initiatives as the Prompt-Pay Bill and Bad Check Reform Legislation.

Senator Golden has been instrumental in the restoration of commuter rail service to the South Shore as well as expansion of water shuttle service to Boston in order to relieve traffic congestion and foster business and employment opportunities for the region. He has worked to obtain a 195 million dollar state bond authorization for the restoration of the Old Colony System.

In 1983 the Senator worked to establish The South Shore Coalition which, in coordination with the Metropolitan Area Planning Council, provides a formal mechanism by which local officials from individual communities can work together for regional planning in growth and development. An early accomplishment of this regional effort was to retain the 617 area code for all South Shore Coalition communities. Senator Golden has successfully passed legislation to permit establishment of similar regional efforts throughout the Commonwealth.

LIEUTENANT GOVERNOR EVELYN F. MURPHY

Lieutenant Governor Evelyn F. Murphy, the first woman elected to constitutional office in Massachusetts' history, is a 47 year old Democrat. She is an economist and former Secretary of Economic Affairs and Secretary of Environmental Affairs in the Dukakis Administrations.

Born in 1940, Murphy spent her early years in Winthrop, Massachusetts. Due to her father's career in the United States Army, she attended public schools across the country.

Murphy graduated from Washington Lee High School in Arlington, Virginia. She earned an A. B. in mathematics from Duke University in 1961, a masters degree in economics from Columbia University in 1963, and a doctorate in economics from Duke University in 1965'

In 1966, Murphy founded a company known as OSTI (Organization for Social and Technological Innovation) in Massachusetts. Through OSTI, she worked on projects such as the reconstruction of Elmwood Park in Detroit with U.A.W. President Walter Reuther and the leaders of Detroit's minority community.

While residing in Lexington in the early 1970's, Murphy founded Ancon Associates in Boston which specialized in areas of education, health care and municipal development. In 1973, she merged Ancon with Llewelyn-Davies Associates and became a partner in that international planning and development firm.

Evelyn Murphy was appointed Secretary of Environmental Affairs by Governor Michael S. Dukakis in 1975. In that post, she supervised over 5000 employees spread throughout five diverse agencies with a total budget exceeding $100 million. She was responsible for the management of the water supply for metropolitan Boston, the statewide forests and parks, fisheries and wildlife programs, the third largest police force in New England, the coastal management programs, and the environmental regulatory agencies.

During her tenure, Murphy led the fight to protect Massachusetts' fishing and tourism industries from off-shore oil drilling. She initiated the state's urban Heritage Park program, and won approval for the first federally designated coastal management program for the East Coast.

President Jimmy Carter named her to Chair the National Advisory Committe on Oceans and Atmosphere. And, in 1978, Murphy was honored by the National Governor's Association, Massachusetts Audubon Society and the National Sierra Club for her distinguished service.

In 1979, Murphy became a Visting Fellow at the John F. Kennedy Institute of Politics at Harvard University. She lectured on environmental issues, worked as a consultant to the Polaroid Corporation, and formed a non-profit corporation designed to help solve the state's hazardous waste disposal problem.

In her first attempt at elective office in 1982, Evelyn Murphy became the first woman in Massachusetts Democratic Party history to win the convention nomination for Lieutenant Governor. After a narrow loss in the Democratic Primary, Murphy was asked by Governor Dukakis to rejoin his cabinet. In 1983, she accepted a position as Secretary of Economic Affairs.

In that capacity, she served as the Governor's chief policymaker in the areas of economic development, job training, employment, tourism, small business and international trade.

Under her direction, Massachusetts launched the "Centers of Excellence" program which uses academic and industrial expertise at the state's universities to foster jobs for Massachusetts citizens into the next century. Her office also developed programs to help low income women, minority and women-owned businesses, and working women achieve economic self-sufficiency.

Murphy molded a partnership with the state's Welfare Department which resulted in "E.T."(Employment and Training Program) for welfare recipients. Recognized as a national model program, her three job training agencies placed over 20,000 poor women in private businesses.

In 1986, Evelyn Murphy announced her candidacy for Lieutenant Governor. She won the Democratic Primary and the state final election. In January, 1987, Evelyn Murphy took the oath of office and became the first woman in Massachusetts' 206 year history to serve in a constitutional office.

Evelyn Murphy also presently serves as Chairman of the National Women Executives in State Governments. And, she remains active in the Democratic Party at both the state and national levels. She addressed the 1980 National Democratic Convention and was a member of the 1984 National Democratic Platform Committee.

In addition to her academic degrees, Evelyn Murphy has also received honorary degrees from Regis College, Anna-Maria College, Simmons College, Curry College and Wheaton College.

RANDALL DAVIS

Randall Davis received his undergraduate degree from Dartmouth, graduating summa cum laude, Phi Beta Kappa in 1970. While at Stanford he was an early contributor to the Mycin Project and developed the Teiresias program, a system for knowledge acquisition in expert systems. He received his PhD in artificial intelligence in 1976 and spent two additional years at Stanford as a Chaim Weizmann Postdoctoral Scholar.

In 1978 he joined the faculty at MIT and held an Esther and Harold Edgerton Endowed Chair from 1979-1981. He is currently a tenured Associate Professor of Information Science at MIT's Sloan School of Management and a member of the Artificial Intelligence Lab. His current research focuses on systems that work from descriptions of structure and function and hence are capable of reasoning from "first principles" to support a wide range of robust problem-solving performance.

Dr. Davis has been one of the seminal contributors to the field of expert systems, publishing some 40 articles and playing a central role in the development of several systems. He serves on several editorial boards, including *Artificial Intelligence*, and *New Generation Computing* (the Japanese journal on the Fifth Generation Project). He is the co-author of *Knowledge-Based Systems in AI*, and presented an Invited Lecture on expert systems at the 1981 International Joint Conference on AI. In 1984 he was selected as one of America's top 100 scientists under the age of 40 by *Science Digest*. In 1986 he received the *AI Award* from the Boston Computer Society for his contributions to the field.

Dr. Davis has been a consultant to several major organizations in the area of AI and expert systems, including the RAND Corporation, IBM, and Schlumberger, for whom he directed the initial construction of the Dipmeter Advisor. He is a founding consultant of Teknowledge and a co-founder of Applied Expert Systems.

Dr. Davis has lectured to numerous academic and industrial audiences, dealing with topics ranging from recent research results to tutorials on expert systems. He has presented full day tutorials on Expert Systems at the American Association for AI annual conferences in 1980, 1982, 1983, and 1985, and the Society for Computer Simulation Conference in April 1985. He has also given shorter overviews to numerous audiences ranging in size from 6 to 1000 and varying in background from CEO's (Citicorp, Aetna, American Express), to technical staff responsible for system construction, to the general public. He has become widely known for his ability to make the ideas and concepts of AI comprehensible to a wide range of audiences.

Dr. Davis has also appeared on *The Macneil/Lehrer Report* (April 1983), *Innovations* (WNET, NY: Sept 83), and played a major role in *This Computer Thing*, a pilot for an educational series (WGBH, Boston) about personal computers. He has been quoted in articles about artificial intelligence in *The New York Times, The Wall Street Journal, Business Week, The Economist, Technology, High Technology*, and *Psychology Today*. An interview appeared in *Computerworld* (Dec 1984); a more recent interview was aired in a segment on National Public Radio's *All Things Considered* in August 1986. In November 1985 he was a featured speaker in Texas Instrument's day-long Satellite Symposium on Expert Systems, with an audience estimated at 35,000.

Robin Kinkead

Director of Design, Kurzweil AI

Mr. Kinkead is a specialist in the design, development, and testing of user/computer interfaces. He joined KAI when it was very small and has grown with the company. He is responsible for managing design and development of the user interface of the company's product line - computer-based document creation with large vocabulary speech recognition. He leads the company's pioneering work in an entirely new field - how people talk to computers.

A research psychologist with an MA from Johns Hopkins University and over 22 years experience in Ergonomics, Industrial Design, product design and test, and standards; Mr. Kinkead was manager of the Product Design group at Xerox and worked on business products and space programs at NCR and Honeywell. He has written over 100 reports on how computers can best fit user's needs (and, ocasionally, vice versa), remembers when the term "user-friendly" was a new concept, and has designed more flawed user interfaces than he cares to count. As well as several that worked out quite well.

Mr. Kinkead also works on planning new products, cooperative ventures, and mechanical design. He enjoys writing and talking about doing and managing the design process.

Dr. Fred L. Luconi

PRESIDENT AND CHIEF EXECUTIVE OFFICER

Luconi, 45, co-founder of APEX, is a recognized leader in the field of information systems strategy and has more than 17 years experience in starting and managing successful high technology firms. Previously, Luconi was Executive Vice President and co-founder of Index Systems Inc., provider of decision support and information systems planning for the financial services industry. Prior to starting Index Systems, Luconi was an Assistant Professor in Computer Sciences at the Massachusetts Institute of Technology (M.I.T.). He also served as a consultant to Arthur D. Little, Raytheon, Hughes Aircraft, and others. He is a graduate of M.I.T., where he received a doctorate in Computer Science with a minor in Management.

JEFFREY A. MELDMAN

Jeffrey A. Meldman is Senior Lecturer in Management and Associate Dean for Student Affairs at the Massachusetts Institute of Technology. His teaching and research focus on legal and social issues related to the use of computer-based information systems, particularly on the protection of personal privacy and of proprietary rights in software.

Dean Meldman received the J.D. degree from Harvard Law School and the Ph.D. degree in computer science from M.I.T. He has served as chairman of the Massachusetts Security and Privacy Council and as a privacy consultant to several government agencies including the U.S. Congress Office of Technology Assessment and the Federal Judicial Center. He has taught on the adjunct faculties of Boston College Law School and of the Franklin Pierce Law Center. He is chairman of the undergraduate program in management science at M.I.T.'s Sloan School of Management.

FRED. W. WEINGARTEN

FRED W. WEINGARTEN is Program Manager of the Communication and Information Technologies Program at the Office of Technology Assessment (OTA). OTA is an agency of Congress responsible for performing long term analyses of technological trends and their impact on public policy. Dr. Weingarten is responsible for such studies done in the areas of telecommunication and information policy. Study topics range from broad overviews of information policy to specific issues such as international negotiation over spectrum allocation and applications of information technology in such fields as education and criminal justice.

Prior to his appointment as Program Manager, Dr. Weingarten gained recognition as an authority on information policy in academia, as a private consultant, and in the Federal Government. At OTA, he was the principal author of the report, Computer Based National Information Systems, which projected for Congress the general trends in information policy over the next decade. He also directed the assessment, Informational Technology and its Impact on American Education.

In 1971, he joined the National Science Foundation (NSF) to form and direct a program of research in the impacts of computers on society. He funded much of the early seminal research in fields such as privacy, computer security, and computer crime. While with the Foundation, he also worked on detail to the Privacy Commission, was a member of the State Department Task Force on Transborder Data Flow, and served on task forces of the White House Committee on the Right to Privacy.

In an earlier tour of duty with the NSF, Dr. Weingarten formed and directed the first program of support for computer science research and was deeply involved with programs of support for research and educational computing in higher education. He then left NSF to teach computer science and direct computing at The Claremont Colleges.

Dr. Weingarten earned a BS degree in engineering from the California Institute of Technology in 1962, and a Ph.D. in Mathematics from Oregon State University in 1966. From there, he accepted a post-doctoral fellowship at the Lawrence Laboratory at Livermore.

Contact at: Congress of the United States
Office of Technology and Assessment
Communications and Information
Technologies Program
Washington, D.C. 20510
(202) 226-2249

ROBERT E. KAHN

Robert E. Kahn is President of the Corporation for National Research Initiatives (NRI), which he founded in 1986 after a thirteen year term at the Defense Advanced Research Projects Agency (DARPA). NRI was created as a not-for-profit organization to provide leadership and funding for research and development of the national information infrastructure.

After receiving a B.E.E. from the City College of New York in 1960, Dr. Kahn earned M.A. and Ph.D. degrees from Princeton University in 1962 and 1964 respectively. He worked on the Technical Staff of the Bell Laboratories and then became an Assistant Professor of Electrical Engineering at MIT. From 1966 to 1972, Dr. Kahn was a Senior Scientist at Bolt Beranek and Newman, Inc., and was a driving force in the development of the Arpanet. In 1972 he moved to DARPA, subsequently became Director of DARPA's Information Processing Techniques Office (IPTO) and initiated the United States government's billion dollar Strategic Computing Program, the largest computer research and development program ever undertaken by the federal government.

Dr. Kahn is a member of the National Academy of Engineering and a member of its Computer Science and Technology Board, a Fellow of the IEEE, a recipient of the AFIPS Harry Goode Memorial Award and the President's Award from ACM; he was twice the recipient of the Secretary of Defense Meritorious Civilian Service Award.

OLIVER B. R. STRIMPEL

Oliver B. R. Strimpel was born in Bombay, India. He grew up in India and Italy and received his higher education in England. He won a scholarship to Cambridge University where he received the Bachelor of Arts degree in Natural Sciences in 1974. He then received a Master of Science in Astronomy from Sussex University in 1975 and a Doctorate in theoretical astrophysics from Oxford University in 1979. During this period he spoke at international astronomical conferences and published several papers on his research.

In 1979 he was appointed curator at The Science Museum, London in charge of the national collections of mathematics and mathematical instruments, computing and data processing and meteorology. He helped set up the major Science Museum exhibits The Challenge of the Chip (1980-1982), Science in India (1982) and Information Technology (1982). For much of his final year at The Science Museum, he created a major permanent gallery at The National Museum of Photography, Film and Television, a new outstation of The Science Museum which opened in 1983, entitled Photography and Beyond - Seeing the Invisible. This gallery included many interactive exhibits using very recent imaging technologies.

In January 1984 Dr. Strimpel was appointed visiting curator at The Computer Museum, Boston, During 1984 he led a team which set up the permanent gallery The Computer and the Image which covers the fields of image processing and computer graphics through images, film, video, holograms and 20 working exhibits, most of which use computers interactively. In January 1985, he was appointed Curator and Associate Director of The Computer Museum, assuming responsibility for the Museum's collections, archives and exhibits. He has spoken at the 1984 annual conference of the ACM's graphics group, SIGGRAPH, and at the annual conference of the Society for the History of Technology (SHOT) where he spoke on computing exhibits in museums. His most recent major exhibition, Smart Machines, presents the history and state-of-the-art in artificial intelligence and robotics in a dynamic exhibit format with many hands-on displays for the visitor.

JOSEPH F. CASHEN

The Board of Directors announced the appointment of a new Executive Director, Joseph F. Cashen, 52, one of the seven original founders of Prime Computer, Inc. Chairman J. William Poduska, Sr. formally introduced Cashen at a Board meeting on February 18, 1987. "When we were at Prime together," Poduska commented, "Joe was always a leader. And now as he accepts the responsibility to direct The Computer Museum, an important resource for the whole industry, he again provides a model of service and integrity. We are extraordinarily fortunate to have Joe at the helm."

Formerly an independent consultant to a number of Massachusetts high tech companies, the new director said, "I joined The Computer Museum because I believe in it. The Museum's size and stage of development allows individuals to make contributions that have major impact. I look forward to building on the established base and helping the Museum to grow into a world class institution with a staff of truly dedicated and talented people." Cashen served as Chief Executive Officer of Acom Computer, Inc., of Woburn, Mass. in 1983. He spent eleven years with Prime, serving as Vice President of Engineering. Previously he was employed in various management positions in the Computer Control Division of Honeywell, Inc.

His appointment highlights an expansion of the Museum's effort to increase the role it plays in educating a wider audience about the technology, applications and impact of computers in today's society. It also marks the beginning of phase two of the Museum's capital campaign. The Museum has raised over three million dollars to date. These funds allowed the Museum to become established downtown. This position must now be firmly secured through the purchase of a half-interest in the building. Campaign Chairman Paul Severino has brought together a talented and diverse team of volunteers, from all corners of the industry, to help raise the three million dollars needed to successfully complete phase two.

Founding President Gwen Bell stated, "I've watched the Museum grow from a lobby to a building; from one person to many; and from static to dynamic exhibits. Many members and supporters have joined along the way. As we enter a new phase of growth, we need further support. There are terrific challenges ahead, in fund raising, membership development, attendance and new exhibits. Please join me in welcoming Joe aboard, and as a loyal supporter, I hope you'll do all you can to help Joe and the Museum meet the important goals ahead."

Smart Choices: *Developing Artificial Intelligence for Massachusetts*

Moderator:
Senator William B. Golden,
Chairman
Senate Special Committee on Long-Range Policy Planning

Keynote Speaker:
Lt. Governor Evelyn F.Murphy

Guest Speakers
Prof. Randall Davis, Co-director
Artificial Intelligence Laboratory
Massachusetts Institute of Technology

Robert Kahn, President
Corporation for National Research Initiatives

Robin Kinkead, Director of Design
Kurzweil Applied Intelligence

Dr. Fred L. Luconi, President and CEO
Applied Expert Systems, Inc.

Jeffrey A. Meldman, Esquire
Senior Lecturer in Management and Associate Dean for Student Affairs
Massachusetts Institute of Technology

Fred W. Weingarten, Program Manager
Congressional Office of Technology Assessment

Committee Staff:
Cynthia M. Costas-Centivany, Director
Robert W. Preer, Assistant Director

January 6, 1988
8:30 am – 12:30 pm

The Computer Museum

Boston Museum Wharf

A Symp[illegible] ... [illegible] ... Committee [illegible] Long Range Policy Planning, The Computer Museum and The Massachusetts [illegible] Foundation, Inc.

COMMONWEALTH OF MASSACHUSETTS
SENATE SPECIAL COMMITTEE ON
LONG RANGE POLICY PLANNING
STATE HOUSE, BOSTON 02133

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SEN. PETER C. WEBBER

CYNTHIA M. COSTAS-CENTIVANY
DIRECTOR

ROBERT W. PREER
ASSISTANT DIRECTOR

FOR IMMEDIATE RELEASE
January 4, 1988

Senator William B. Golden
Contact: Cynthia Costas
or Bob Preer
722-1116

BOSTON - Sen. William B. Golden, D-Weymouth, Chairman of the Senate Special Committee on Long-Range Policy Planning, will moderate a symposium on the development of artificial intelligence in Massachusetts to be held January 6, 1988 from 8:30 a.m. to 12:30 p.m. at the Computer Museum, 300 Congress St., Boston.

The event is being co-sponsored by the Senate Special Committee on Long-Range Policy Planning, the Computer Museum and the Massachusetts Future Foundation.

The conference will be the first gathering in Massachusetts of leaders in government, business and academia, as well as the general public, to discuss the role of the state in the development of this important field of computer science.

Artificial intelligence is a rapidly emerging set of technologies in which computers mimic human abilities, including reasoning, seeing and communicating. Artificial intelligence has the potential to have a profound impact on the way we live and work.

- more -

The development of artificial intelligence also is the subject of intense international competition. The industry has deep roots in the state, and its success here could be important to the future of the Massachusetts economy.

The symposium is the first public event sponsored by the Senate Special Committee on Long-Range Policy Planning, which was established last year to study major economic, technological and social trends that will affect the state during the remainder of this century.

"The symposium is part of an ongoing effort by the Special Senate Committee to foster technology development through focused, long-range planning," said Golden. "We plan to establish a multi-disciplinary task force of government, business and academic leaders to develop and implement a state plan for developing the artificial intelligence industry in Massachusetts. If government and business work together, we have the opportunity to lead the world in this revolutionary new technology."

The keynote speaker at the symposium will be Lt. Governor Evelyn F. Murphy. The other speakers are Prof. Randall Davis, co-director of the Artificial Intelligence Laboratory at M.I.T.; Robert Kahn, President of Corporation for National Research Initiatives; Robin Kinkead, Director of Design for Kurzweil Applied Intelligence; Fred L. Luconi, President of Applied Expert Systems; Jeffrey Meldman, Senior Lecturer in Management at M.I.T.; and Fred W. Weingarten, Program Manager at the U.S. Congressional Office of Technology Assessment.

[redacted]

SENATE . . . . . No. 1530

[Senate, January 8, 1987 — Offered by Senator William B. Golden]

The Commonwealth of Massachusetts

In the Year One Thousand Nine Hundred and Eighty-Seven.

Ordered, That there is hereby established a special committee on long range policy planning, comprised of six members of the senate for the purpose of conducting an investigation and study of major economic, technological and social trends and developments which will significantly impact the commonwealth, its citizens, its families and its business environment through the remainder of this century. Said investigation and study may include, but not be limited to, the role of state government in maintaining the economic competitiveness of the commonwealth in a world economy, and the potential impact of technology futures on the commonwealth and its citizens; ~~and recommendations for enhancing the legislature's institutional capacity for anticipating such change through its planning and policy formulation functions.~~ The committee may hold hearings and may consult and contract with project contributors chosen from government, industry, academia and the public at large, including legislators, economists, attorneys, scientists and other qualified individuals both within and without the commonwealth. Said committee shall report the results of its study and its recommendations, if any, together with drafts of legislation necessary to carry such recommendations into effect, by filing the same with the clerk of the Senate on or before the first Wednesday in December, nineteen hundred and eighty-eight.

Order adopted as amended on 1/22/87.

[redacted]

MASS. GEN. LAWS : SM28 Insert 3

COMMONWEALTH OF MASSACHUSETTS
SENATE SPECIAL COMMITTEE ON
LONG RANGE POLICY PLANNING
STATE HOUSE, BOSTON 02133

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SEN. PETER C. WEBBER

CYNTHIA M. COSTAS-CENTIVANY
DIRECTOR

ROBERT W. PREER
ASSISTANT DIRECTOR

AI Symposium Questionnaire

1) Your Name: _____

2) Your Title: _____

3) Your Business Address: _____

_____

Please answer the following questions:

a) Did you find your attendance at the AI Symposium to be helpful? If so, how?

_____

_____

b) Would you be interested in reviewing a final draft report of state government policies and the AI industry?

_____

c) Would you recommend a person or organization we should contact to review a final draft of our proposal for state government policies and the AI industry? If so, please state their name, address and phone number.

_____

d) What do you think we should do to ensure AI development as a benefit to Massachusetts citizens?

_____

_____

_____

_____

AN EXHIBITION ON

COMPUTER AIDED

LONG RANGE PLANNING

Automated Land Information Systems (LIS), Geographic Information Systems (GIS) and Dynamic Archival Systems (DAS) are some of the prime computer based approaches being developed today to map the future of regions, cities and towns of North America. This exhibit documents recent DAS studies related to Boston Harbor carried out by Jung/Brannen planners and designers.

For every level of planning all relevant contextual information is incorporated in an associative hierarchical data base. By using graphic and alpha-numeric data to record existing natural and man-made forces and proposed facilities, the impact of new development on a specific region or site can be clearly defined, evaluated and communicated. In this manner a number of alternative "what-if?" scenarios can be visually simulated and tested for their relative merits and impacts on the rest of the contextual data.

The integrated data base saves times, focuses all known pertinent data, reduces errors and improves the quality of decisions. In this manner it imparts "artificial intelligence" to the CAD based planning process.

This exhibit constitutes one part of a larger planned exhibition on the use of computers in planning and design that Jung/Brannen Associates, Inc. of Boston, Massachusetts has under preparation. It is presented in conjunction with the Computer Museum in recognition of the symposium entitled: Smart Choices: Developing Artificial Intelligence for Massachusetts.

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STATE POLICY ISSUES FOR ARTIFICIAL INTELLIGENCE RESEARCH AND DEVELOPMENT

Working Paper

December 14, 1987

Senate Special Committee on Long Range Policy Planning
State House
Boston, Massachusetts

This Working Paper was prepared by Edward F. Morrison, a consultant to the Senate Special Committee on Long Range Policy Planning. It is intended for discussion purposes only. The views expressed do not necessarily represent the views of the Senate Special Committee or any member of the committee.

I. Overview: The Special Committee on Long Range Policy Planning

The Senate Special Committee on Long Range Policy Planning was established to analyze major economic, technological, and social trends which will affect the Commonwealth through the remainder of the century. It is an ambitious, flexible mandate.[1] There are problems in pursuing it. Thinking about the future is not easy: ideas are hard to pin down, thinking often gets fuzzy, and discussions are difficult to structure.

To avoid these pitfalls, the committee has chosen to pursue a limited number of focused initiatives, all designed to experiment with new approaches to policy development. Beginning in November, the chairman of the committee, Senator William B. Golden, joined with Senate President William M. Bulger to host a series of forum discussions for members of the Senate. At these monthly meetings noted outside experts have been invited to share their views on major issues facing the Commonwealth.[2] In January, the committee will sponsor a conference on artificial intelligence (AI). Its purpose is to bring noted researchers

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1. Senate Bill 1530, which authorized the Select Committee, indicates that the committee's work may include analyzing "the role of state government in maintaining economic competitiveness of the commonwealth in the world economy; and the potential impact of technological futures on the commonwealth and its citizens."

2. On November 5, Robert Reich, a member of the faculty of the John F. Kennedy School at Harvard University was guest at the first forum. Future scheduled speakers include John Kenneth Galbraith and Lester Thurow.

and technical experts together with policy makers and the public to discuss the development of artificial intelligence and its implications for the Commonwealth. Following the January conference, the committee will turn its attention to other specific issues which will shape the state's econmomy over the next decade.

The Special Committee has chosen to focus initially on artificial intelligence for several reasons. AI represents a field of computer science dedicated to giving computers cognitive and motor skills that mimic human abilities. These attributes include reasoning, seeing, and communicating. AI represents a set of technologies with tremendous potential to shape the way we work, think, and interact with one another. Second, it is a young industry but one with deep roots in the state economy. Finally, artificial intelligence represents as a rapidly emerging set of market opportunities. By studying these opportunities more closely, our state political leaders have a chance to think concretely about ways in which the Massachusetts economy will likely evolve.

This Working Paper has been prepared in conjunction with the January conference. The next section defines some specific issues that need to be considered before a state policy toward artificial intelligence can be reasonably considered. Each issue is followed by a brief discussion outlining a set of working hypotheses for resolving these issues. These propositions need to be discussed and tested empirically, and the committee would

like to encourage comment on them. The final section of the paper outlines some broad policy options that Massachusetts could consider in promoting artificial intelligence. These policy options are a preliminary effort to structure some logical connections between the working hypotheses and policy prescriptions.

The purpose of this paper is not to present a blueprint for a state policy -- or even to presume that, in the case of artificial intelligence, an explicit state policy is appropriate at all. Its purpose is to encourage debate on some new approaches of thinking about how to develop a coherent state policy toward emerging technologies with exciting potential for the Commonwealth.

II. Issues in Defining a State Policy Toward Artificial Intelligence

Issue 1: How should "artificial intelligence" be defined?

Working Hypothesis 1A: State policy should avoid referring to an artificial intelligence industry. In practical terms, there is no such industry. Artificial intelligence represents a series of related technologies, for which companies are now seeking commercial applications.

Working Hypothesis 1B: In exploring policy alternatives, state policy makers should focus on companies seeking to develop commercial software applications. These firms have the greatest

potential for expanding employment and improving the competitive position of the Commonwealth.

Discussion: Defining an artificial intelligence "industry" is a little like trying to describe a constantly changing sunset. At its core, artificial intelligence represents a basket of promising computer science technologies. Within each technology there is a complex, evolving network of professional and commercial relationships stretching from university research labs to a number of emerging markets.

Tracing these networks is difficult, but the best place to start is at local universities. Research labs, such as those at Massachusetts Institute of Technology and the University of Massachusetts, have undertaken the basic work that has led to the development of many commercial AI products.[3] The commercial "spin-offs" from university research involve three major types of companies: those that design and manufacture the machines on which most sophisticated AI applications run; those that design and market AI programming languages; and those that produce

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3. Much of this basic research has been funded by the federal government, principally through the Department of Defense. In 1987, the federal government will spend an estimated $72.5 million on basic AI research; 90% will come from defense agencies, much of it from the Defense Advanced Research Projects Agency. "Federal Funding for Artificial Intelligence Research and Development," Office of Technology Assessment, Staff Paper, (June 1987), p 7.

specific products that apply AI technology to solve particular industrial problems.[4]

The applications companies are the most heterogeneous group, and in many respects they are the most interesting. These companies are attempting to define products that use AI technologies in order to solve everyday problems: How can a chief financial officer keep up with the torrent of financial information that threatens to swamp his company? Can a machine be designed to sew a pocket on a shirt? What steps can a plant manager take to improve productivity by scheduling production more efficiently? How can computer software be made easier to use?

There are at least eight areas in which applications companies have focused their efforts:

> Expert Systems.-- This area involves products which replicate the reasoning of experts in a particular technical or professional field. Expert systems firms often represent what much of the public regards as artificial intelligence. These firms began with developing customized applications for particular users, but they have recently moved into marketing more generalized products for broader markets, such as the financial services industry.
>
> Natural Language Processing.-- This area is seeking to develop easier ways for people to communicate with

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4. Symbolics, a dominant producer in the LISP machine market, is an example of a hardware firm. Gold Hill Computers markets a series of AI programming language products, including Golden Common LISP ("LISP" stands for List Processing language, initially developed in 1960, which has emerged as a popular AI language.) Palladian is a good example of an applications company. Its first product, The Financial Advisor, was design to assist companies with financial planning and control. All three have offices in Cambridge.

computers. Instead of learning a set of unique computer commands, software with natural language processing will allow an operator to use a straightforward command, such as "Let me see the Western Region's sales reports for 1987." In contrast to voice recognition technologies, natural language processing is limited to communication through a computer keyboard.

Language Translation.-- This technology will give a computer the ability to translate text from one language to another.

Machine Vision.-- Artificial or machine vision refers to technology designed to give computers the ability to see objects. This technology has been actively promoted by the auto industry for applications such as inspection, assembly, and process control. Machine vision is also central to the development of robotics.

Voice Recognition.-- This technology involves developing the ability of a computer to respond to spoken words.

Intelligent Sensors.-- Used in the field of robotics, intelligent sensors enable a computer to "feel" objects. These technologies are useful for fragile manipulation and movement by robots.

Robotics.-- These technologies involve the development of machines that can move and manipulate objects. Robotics is a general term which generally applies to flexible ("soft") automation, as well as intelligent, fixed ("hard") automation. Robotics includes the integration of other AI technologies, including vision systems, intelligent sensors, and programs for interpreting and reacting to visual and tactile data.

Speech Generation.-- These technologies allow a computer to generate sounds which mimic human speech.

Focusing on applications companies turns around prevailing notions of government support for research and development. Under the Reagan Administration, government funding for technology development is generally focused on basic

research, where ties to the commercial market are weakest.[5] But this approach may not make sense for Massachusetts.

Several propositions support the view that state government should focus its attention on commercialization of AI technology, not basic research. First, the state does not have the funds to support major grants and contract work in basic R & D. In a period of increasing concern over the state's budget, a basic research program would also be difficult to sustain politically. And without continuous funding, a basic research program would be of little value to university researchers. In addition, by focusing on applied research and the institutional arrangements by which applied research is translated into marketable products, the state has more flexibility and leverage.

Issue 2: How are artificial intelligence products developed for commercial markets?

Working Hypothesis 2A: In analyzing options for policy, state policy makers should think of the innovation process as a pipeline stretching from basic research to commercial applications.

Working Hypothesis 2B: State innovation policy should recognize that money and management -- mobilized by private firms -- move technology down the pipeline. As technology is translated to commercial products, the managerial and financial

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5. See Congressional Budget Office, "Federal Support for R & D and Innovation," (April 1984), p. xvi.

demands on the firm shift. Effective state policy should be predicated on an understanding of the competitive pressures facing individual firms as they attempt to commercialize products.

Discussion: Before state policy options can be sensibly defined, a context must be drawn. There are many different models of innovation; there is no standard path for a technology to find a market. But description of the innovation process usually relies on the metaphor of a "pipeline". At one end of the pipeline is basic research; at the other, commercial products.[6] In between are a series of steps, including the identification of potential commercial applications, the assessment of technical feasibility, the preparation of product specifications, the development of product prototypes, market testing, the reassessment of commercial potential, and marketing.

There are two major resources that fuel the drive toward the market: money and management. As an individual or firm moves through the pipeline, the needs for financing -- both the nature and the size of financial commitments -- change. Venture capitalists conventionally talk about a number of different stages in financing a commercial enterprise:

> Seed Financing.-- This money is used to develop a product concept, including a prototype.
>
> Start up.-- Financing at this stage is used for further product development and initial marketing.

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6. Congressional Budget Office, op. cit., p. 5.

> First Stage Financing.-- First stage financing is required if a product is accepted by the market and expanded manufacturing and marketing plans are warranted.
>
> Second Stage Financing.-- This financing generally represents working capital required to finance increasing sales.
>
> Third Stage Financing.-- Funds at this stage are used for a major expansion in a firm that is breaking even or beginning to show a profit. Funds may be dedicated to working capital or fixed assets.
>
> Fourth Stage Financing.-- This is the last stage of private financing before a company goes public. It is often structured as bridge financing which is repaid with the proceeds of a public underwriting.[7]

Similarly, successful innovation requires different technical and management skills as a specific technology moves toward commercial products. The development of commercial products involves a complex alignment of technology with customer functions ("What will the technology do for the customer?") and customer groups ("Who will buy technology that serves this particular function?"). The mix of technical and managerial skills within a successful enterprise shifts as these questions are resolved. At the initial stages, technical creativity is most critical for success. As the commercial potential for a specific technology emerges, managerial skills -- the ability to get things done -- becomes more important.

Issue 3: What problems typically arise to slow the development of commercial AI products?

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7. See Stanley Pratt, ed., Guide to Venture Capital Sources, (sixth edition), pp. 2-3.

Working Hypothesis 3A: Identifying obstacles to the commercialization process requires extensive industry research. Before acting, state policy makers should hold detailed consultations with industry representatives.

Working Hypothesis 3B: Participants involved in AI have different perspectives on potential problems in the innovation process. To get an accurate view of the process, policy makers need to sample a variety of viewpoints.

Discussion: When state development policies break down, it is usually because programs lose touch with markets. Good policy is fueled by good industry research. With innovation, the problem is tricky. Markets are defined by the strategic choices made by individual firms. In emerging markets, companies continuously jockey for competitive position. They experiment with different approaches to the product market. To be effective, new state programs should be designed to fit as tightly as possible with these strategies. To keep programs relevant, policy makers must figure out a way to keep abreast of strategic shifts.

The problem of keeping current with emerging markets is complicated by another factor: market participants have their own biases. Venture capitalists worry about financing, scientists worry about research budgets, managers worry about competition. Through on-going hearings, interviews, and other research, state policy makers must assemble a sensible collage of viewpoints and articulate a clear public interest.

Issue 4: What role, if any, should the state government play in addressing these obstacles to commercialization?

Working Hypothesis 4A: A state innovation policy for AI should address a set of problems that is sufficiently widespread to support a consensus within the business community. If there is no consensus on the appropriate role for state government, the best approach is to do nothing.

Working Hypothesis 4B: Analysts never have all the facts. Economies never stand still. Any state policy that is proposed must be sufficiently flexible to adjust to bad assumptions and changing circumstances.

Discussion: A successful state innovation program must address specific market problems. Good programs generally have five key attributes:

1. They are founded on simple, common-sense goals that can summon consensus and sustain action over time.

2. They are concrete and accountable. They are run by qualified professionals who expect to be held accountable for results. Good programs are submitted to regular evaluation and are continuously subject to revision.

3. They are closely bound to the competitive concerns of individual firms, and they grow gradually over time as program managers learn the details of the market.

4. They are informed by a sophisticated appreciation of the external environment -- changes in the regional, national, and global economies -- that shape and constrain state initiatives.

5. They are market-based; they muster public resources to focus and subtly redirect market forces to align them better with realistic public goals rather than attempting bluntly to countermand the market.

Issue 5: What are the social implications of artificial intelligence and what role, if any, should the state government have in addressing these implications?

Working Hypothesis 5: The state government has a special responsibility to research and anticipate the social consequences of AI technology.

Discussion: No one knows the consequences of AI applications will be. And it is difficult to think precisely about the problem when so little is known about how these technologies will be developed and marketed. One thing is certain: if the consequences of AI technology are sufficiently widespread to generate political repercussions, the state government will face increasing pressure to regulate the technology.

Major technological change often creates dislocations in employment. Although the goal of AI is to make workers more productive, one foresseable consequence is the elimination of

some routine clerical -- and even professional -- jobs. The difficulty in forecasting these impacts stems not only from the newness of the technology, but also from the potential of AI to cut across economic sectors. For AI, the distinction between blue collar and white collar jobs is obsolete.

Consider this scenario. The development of expert systems for the financial services industry proves to be wildly successful in the 1990's. Many firms adopt these systems to boost the productivity of their "back office" operations. As a consequence, a large number of workers -- mostly lower paid females -- are out of a job. It is not hard to imagine the state legislature coming under pressure to enact "office closing" legislation. We would be facing a replay of the debates over plant closings that occurred several years ago.

Potential employment problems will be cushioned by the self-correcting mechanisms of the market. The development of new technologies takes years, and AI is no different. As new products are introduced, some jobs will undoubtedly be eliminated, but others will be created. These transitions, triggered by AI, will ripple through our educational and training system. Pressure will build on workers to be more flexible and technologically literate. Job changes -- and even career shifts -- will gradually become more common. Education will be seen less as a discrete event and more as a lifelong process.

State government is in the best position to anticipate the social consequences of AI and to formulate sensible policy

options. Playing this role effectively requires two steps. First, state government must stimulate focused empirical research on these questions. Without better data on the consequences of AI, there can be no rational discussion on the need for regulation. Second, before any administrative scheme is enacted, state government must wait until a clear public consensus evolves on its need.

III. Potential Policy Options

We are accustomed to thinking of successful public programs as the product of a linear process moving from problem definition to policy prescription. It seldom happens that way. Policy making is an iterative process, a process of experimentation and optimization. Problems are defined based often on hastily drawn assumptions. Policies are proposed to respond. A consensus often fails to develop initially, and new data are subsequently introduced to the debate. Assumptions are rechecked. Alternative policies are put forth, and renewed efforts are made at consensus. The fitful process keeps going until a new program is born or the participants give up in frustration or exhaustion.

Many public studies about the future get into trouble by ignoring this process. Policy ideas must lead someplace. A laundry list of good ideas is of little value if there is no thought given to how these recommendations can be translated into politically pragmatic proposals. Ignoring the practical aspects

of legislative politics typically gives rise to two problems. The first is over-ambition. Analysts are often tempted to draft one big strategy document to deal with all issues at once. It is not easy to do, and there is one major pitfall: grandiose public plans are hard to explain. They cannot easily be rendered into a set of simple messages that ring true in the ears of legislators, the press, and the general public.[8]

The second problem is fuzziness. A good plan must recommend action, not simply endorse attitudes. The process of developing any public strategy -- whether it is for AI, education, or health care -- should be an organizational seed crystal. Specific groups, with specific interests and resources must sign on to give the political process force. A good strategy should have sharp hooks to catch the right constituencies. Vague strategies either fail to muster organizational resources or they subordinate new initiatives to old agendas.

One way to avoid these difficulties is to begin early to experiment with potential policy options. With AI the task is complicated, because so little is known about the commercial potential of these technologies. The best alternative for the state may be to do nothing. On the other hand, by exploring several policy paradigms, we may be able to begin to shape the contours of a sensible state innovation policy for AI.

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8. Perhaps the clearest example of this type of failure was Rhode Island's Greenhouse Compact, a conceptually sound, but politically flawed economic masterplan.

Policy Option 1: Establish a Center of Excellence for Artificial Intelligence

Modeled after the other centers, this initiative would seek to pull together industry with existing university researchers to explore the application of specific AI technologies. A Center of Excellence would be designed to complement existing university research programs.

Policy Option 2: Establish a state sponsored but privately managed venture capital fund for financing applications companies in artificial intelligence.

This proposal presumes that fledgling AI applications firms are having difficulty raising capital from the existing venture capital community. A state venture capital fund would work to leverage private funds for AI applications companies on a ratio of 1:3 or 1:4. The fund would be restricted to investing in firms located in Massachusetts.

Policy Option 3: Establish a state office of technology assessment which would monitor AI along with other promising technologies.

It may be unwise to fashion a specific state AI policy at this time, but the state may need a mechanism for keeping up with AI and other leading edge technologies. An office of technology assessment, modeled after a similar organization serving the U.S. Congress, could conduct wide ranging studies on the impact of AI on the Commonwealth's economy.

Policy Option 4: Establish a state program to encourage smaller AI applications firms by purchasing innovative AI products for state agencies.

Through a relatively small set-aside, the state government could underwrite the development costs of innovative AI products by fledgling firms. This program could be administered centrally or under the auspices of a specific agency, such as the Department of Revenue. The program would be supported by an advisory committee of outside technical experts. The program would emphasize products that could both increase the productivity of state government and lead to significant commercial spin-offs.

Policy Option 5: Review state securities law to insure that the emergence of AI firms is not hampered by inappropriate state regulation.

In addition to considering options to encourage innovation through subsidies and new institutional arrangements, the state should also focus on steps that can be taken to eliminate unnecessary regulatory obstacles to emerging firms. State securities laws, while designed to protect public investors, may have the perverse effect of discouraging emerging AI firms from expanding in Massachusetts.

December 5, 1987

You are cordially invited to a symposium, ***Smart Choices: Developing Artificial Intelligence for Massachusetts****, to be held from 8:30 AM to 12:30 PM on January 6, 1988 at the Computer Museum in Boston. This will be the first gathering in Massachusetts of business, government and academic communities, as well as the general public to explore the development of artificial intelligence and its impact on society.*

Artificial intelligence has the potential to transform life in the 21st century. At the very least, it will mean profound changes in lifestyles, employment and the way we understand ourselves. The development of the technology also is the subject of intense international competition. America's standing in the world economy may hinge on our success in developing artificial intelligence.

The symposium is being organized by the Senate Special Committee on Long-Range Policy Planning and is co-sponsored by the Computer Museum, the Massachusetts Future Foundation and other private groups. The focus will be the role government can play in promoting, managing and regulating the development of artificial intelligence.

The program will feature speakers who are leaders in artificial intelligence. They will offer government, industry and academic perspectives on the development of the technology. There also will be a question and answer session and an open discussion.

In addition, the Computer Museum's exhibit on Artificial Intelligence will be open to those attending the symposium. The exhibit includes demonstrations of expert systems and robotics, as well as a history of the development of artificial intelligence.

I hope you can join us for this important event.

Sincerely,

Bill Golden

William B. Golden

Smart Choices: Developing Artificial Intelligence for Massachusetts

January 6, 1988
8:30 AM to 12:30PM

The Computer Museum,
300 Congress Street, Boston,
Massachusetts 02210 (617) 426-2800

For business people, academicians, state legislators and other government officials, and the public.

Agenda

8:30 - 9:00	Registration/coffee/pastries
9:00 - 9:05	Introductory remarks by State Senator William B. Golden, Chairman of the Senate Special Committee on Long-Range Policy Planning
9:05 - 9:20	Keynote Speaker - Lt. Governor Evelyn F. Murphy, Advisory Board Member, The Artificial Intelligence Fund "Artificial Intelligence and the Economic Future of Massachusetts"
9:20 - 9:45	Speaker - Professor Randall Davis, Associate Professor of the Sloan School of Management and Co-Director of the M.I.T. Artificial Intelligence Lab "Artificial Intelligence as Defined"
9:45 - 10:00	Speaker - Robin Kinkead, Director of Design Kurzweil Applied Intelligence "Artificial Intelligence as Applied"
10:00 - 10:15	Speaker - Dr. Fred L. Luconi, President, CEO, Applied Expert Systems "Artificial Intelligence as Applied"
10:15 - 10:40	Speaker - Jeffrey A. Meldman, Senior Lecturer in Management and Associate Dean for Student Affairs at M.I.T. "Artificial Intelligence and Related Legal Issues"
10:40 - 11:05	Speaker - Fred W. Weingarten, Congressional Office of Technology Assessment "Labor Implications of Artificial Intelligence"
11:05 - 11:30	Speaker - Robert E. Kahn, Formerly with U.S. Defense Advance Research Projects Administration (DARPA) and currently with Corporation for National Research Initiatives "The Government Role in the Development of Artificial Intelligence"
11:30 - 12:15	Panel Discussion Speakers will accept questions from the audience and comment on points raised by other speakers.
12:15 - 12:30	Closing Remarks by Senator William B. Golden Oliver Strimpel, Curator of The Computer Museum will invite audience to tour museum.